UNEP

Convention on Biological Diversity

Distr.
GENERAL

UNEP/CBD/EW-IPALS/1/2
21 October 2008

ORIGINAL: ENGLISH

EXPERT WORKSHOP ON INTEGRATING
PROTECTED AREAS INTO WIDER
LAND- AND SEASCAPES AND SECTORS
Isle of Vilm, Germany, 1-4 November 2008

CONNECTING THE DOTS: A DRAFT GUIDE TO INTEGRATING PROTECTED AREAS INTO WIDER LANDSCAPES, SEASCAPES AND SECTORS

Note by the Executive Secretary

A working document for the Workshop

The purpose of this workshop is to develop a draft guide for the integration of protected areas into wider land- and seascapes and relevant sectors so as to maintain ecological structure and function of the areas under protection, and enhance protected area effectiveness. The Secretariat commissioned a team of experts to develop background materials and propose elements of a guide that could facilitate discussions leading to the drafting of the guide.

This working document contains the background materials collected and proposed elements for the guide. Section I deals with the background and introduction. In section II, the eight key steps identified for integration processes are described giving some examples and best practices. Three preliminary case studies are described in section III. A detailed but not an exhaustive list of references is given at the end.

The workshop will discuss the structure of the guide, the steps for integrating protected areas into wider land and seascapes, and the logic in the sequence of steps. The workshop will refine and revise the contents including identification of additional case- studies, best practices and resources. Based on the deliberations in the workshop, a first draft of the guide will be prepared and circulated widely for peer-review and for additional case-studies before finalization.

WORKING DOCUMENT FOR THE WORKSHOP

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SECTION I: INTRODUCTION

1.1 Introduction and background

Rationale for integrating protected areas into the wider landscape and seascape

1. The establishment of a global network of protected areas, encompassing more than 13 percent of the world's terrestrial surface, is the largest single land and sea use decision in human history. The rapid growth in the number and coverage of protected areas can be considered one of the greatest conservation achievements of the last century.

2. Yet by any measure, the current rates of biodiversity loss have exceeded historical norms by several orders of magnitude, leading to what many authors have called the sixth great extinction event of life on earth (Vitousek et al., Wilson, 2007). A recent study by the World Wildlife Fund highlights the precipitous decline in species populations worldwide in terrestrial, marine and freshwater ecosystems (Loh, 2006). In a similar report, trends in the ecological footprint clearly show that humans are having an enormous impact on the world (Sanderson, 2002; WWF, 2007).

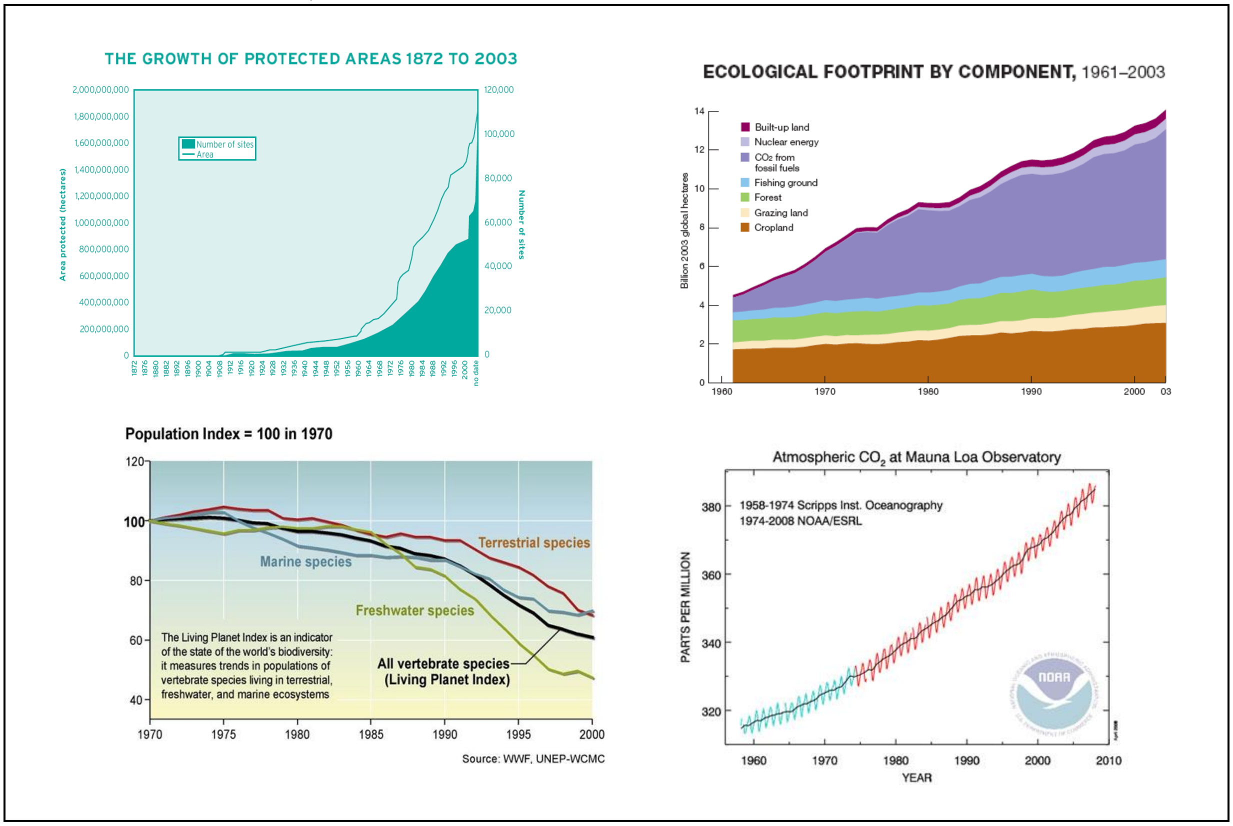
3. These three trends – the rise in protected areas, the decline of species and the increasing human footprint, provide conservationists with a conundrum. Efforts over the past few decades have focused largely on the designation of individual protected areas, with only marginal efforts to integrate protected areas and biodiversity conservation into mainstream society. Although they are a cornerstone of any strategy for conserving biodiversity, protected areas alone are insufficient for preventing further declines in biodiversity losses, as clearly shown in Figure 1. The conservation community must investigate the causes of biodiversity decline, and must explore strategies that look beyond the creation of isolated protected areas, towards more integrated strategies across wider landscapes and seascapes.

4. Chief among the causes of biodiversity decline are habitat loss and fragmentation, and resulting disruptions in ecological processes (Bennett, 2003). Between one-half and one-third of the earth's land surface has been degraded or converted to non-natural habitat (Vitousek et al., 1997), resulting in unprecedented levels of fragmentation. Habitat fragmentation, defined as the conversion of large blocks of continuous areas of habitat into smaller separated blocks (Anderson and Jenkins, 2006), contributes to biodiversity losses in several ways: 1) it reduces the overall quantity of habitat available; 2) it decreases the quality of habitat by increasing the exposure to invasive species, to fire and to other edge effects; 3) it concentrates species populations into smaller patches, thereby increasing competition for scarce resources; 4) it restricts species movement, thereby reducing genetic vigor and overall resilience; and 5) it disrupts key ecological and evolutionary processes upon which species depend (Anderson and Jenkins, 2006; Mackey et al., 2008).

5. The need to integrate protected areas into the wider landscape is imperative, and will only become more so each year. In particular, habitat fragmentation will become an increasingly urgent issue because of the synergies between fragmentation and climate change (Thomas et al 2004; De Dios et al., 2007). Fragmentation impairs the ability of a species to adapt to the rapidly shifting habitat patterns and ecological processes that result from climate change, further weakening their resilience, and increasingly the likelihood of local and widespread extinctions (Opdam and Wascher, 2004). Because the severity and distribution of impacts from climate change is so uncertain, the maintenance of landscape connectivity across biophysical gradients is essential to safeguarding biodiversity. Furthermore, climate change will continue to have widespread impacts on natural resource sectors, which in turn alter the constraints and opportunities for conservation.

6. It is particularly urgent, therefore, that conservation planners create integrated national and regional networks that not only provide for the persistence of species today, but that also anticipate and provide for the persistence of species under different climate change scenarios in the future. This will require a much higher level of integration between protected areas and the surrounding environment than is currently the case in the vast majority of countries.

Figure 1: Trends in protected areas, species declines and human impacts (WCMC, 2003; EBI, 2003; WWF, 2005; Loh, 2007)



7. Taken together, these four trends – the rapid increase of protected areas, the equally rapid decline of species, the continued growth of human impacts across the globe, and the acceleration of biodiversity loss from climate change in the future (Figure 1) – all point toward the urgent need for a more integrated conservation strategy.

8. Integrating protected areas and ecological networks into wider landscapes is imperative not only for maintaining and protecting biodiversity, but also for maintaining and protecting the suite of ecosystem services that flow from these landscapes and networks. The continued fragmentation of habitats is likely to result in the loss of ecosystem services upon which all life depends, including human life. The priceless benefits of clean drinking water, crop pollination, storm mitigation and carbon sequestration are all at risk from habitat fragmentation (Lindenmayer and Fischer, 2006; Birdlife International, 2007).

Rationale for integrating protected areas into broader natural resource sectors and policies

9. Fragmentation in the physical landscape is not the only issue in designing effective ecological networks; fragmentation in biodiversity and protected area policies also results in challenges, constraints

and barriers in the conservation of biodiversity. Perverse subsidies, inappropriate natural resource policies, unregulated land development, and inadequate land use planning all constrain the ability of conservation planners to design and implement effective ecological networks (Petersen and Huntley, 2005).

10. Protected areas are part of the solution to slowing trends in fragmentation and resulting biodiversity loss, but they are not enough. Any long-term solution must focus not only on a suite of protected areas and the lands and waters that connect them, but also on the broader matrix of laws, policies and practices within which this ecological network exists (Machlis and Force, 1997). It is this policy and sectoral matrix that will determine whether or not the ecological network can achieve its ultimate objective – to sustain a representative suite of biodiversity into the foreseeable future.

11. Therefore, this guide focuses on two aspects of protected area integration The first aspect focuses on how to integrate protected areas into the broader physical landscape and seascape. Included in this phase are the steps needed to envision, assess, plan, implement and monitor a suite of integration strategies, primarily focused on buffers, corridors and sustainable use areas. The second aspect focuses on how to integrate protected areas into broader policies and sectors, including steps needed to assess, plan, implement and monitor a suite of policy-related strategies. Because these two aspects are highly interrelated, and even at times indistinguishable, the process for integrating protected areas into the the landscape and related sectors is itself described as part of an integrated process in this guide. Section II of this guide describes this integrated process in a series of sequential steps.

The relationship of this guide to the CBD Programme of Work

12. The aim of the Convention on Biological Diversity (CBD) is the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the utilization of biological diversity. Several decisions of the CBD have a direct bearing on this guide, including decisions that help biodiversity adapt to climate change:

> CBD Decision VII/15 which '*Encourages Parties to take measures to manage ecosystems so as to maintain their resilience extreme climate events and to help mitigate and adapt to climate change*'.
>
> CBD Decision VIII/30 which '*Encourages Parties and other Governments to cooperate regionally in activities aimed at enhancing habitat connectivity across ecological gradients, with the aim of enhancing ecosystem resilience and to facilitate the migration and dispersal of species with limited tolerance to altered climatic conditions*'.

13. In addition to these decisions, there is a specific CBD Programme of Work on Protected Areas (PoWPA). The overall purpose of the PoWPA is to support the establishment and maintenance of comprehensive, effectively managed, and sustainably funded national and regional systems of protected areas by 2010 (by 2012 for marine areas). The PoWPA is organized into four elements: 1) actions aimed at planning, selecting, establishing, strengthening and managing protected area systems and sites; 2) actions aimed at improving governance, participation, equity and benefit sharing; 3) actions aimed at improving the enabling environment for protected areas; and 4) actions aimed at developing standards for assessment and monitoring (CBD, 2004).

14. Although this guide involves all four elements of the PoWPA, it is the first target, specifically Target 1.2, which has the greatest relevance. The goal of Target 1.2 is "To integrate protected areas into broader land- and seascapes and sectors so as to maintain ecological structure and function," with the aim being that by 2015, all protected areas and protected area systems are integrated into the wider landscape

and seascape, and into relevant sectors (CBD, 2004). The PoWPA calls on governments to take the following actions:

> Action 1.2.1. Evaluate by 2006 national and sub-national experiences and lessons learned on specific efforts to integrate protected areas into broader land- and seascapes and sectoral plans and strategies such as poverty reduction strategies.
>
> Action 1.2.2. Identify and implement, by 2008, practical steps for improving the integration of protected areas into broader land- and seascapes, including policy, legal, planning and other measures.
>
> Action 1.2.3. Integrate regional, national and sub-national systems of protected areas into broader land- and seascape, inter alia by establishing and managing ecological networks, ecological corridors and/or buffer zones, where appropriate, to maintain ecological processes and also taking into account the needs of migratory species.
>
> Action 1.2.4. Develop tools of ecological connectivity, such as ecological corridors, linking together protected areas where necessary or beneficial as determined by national priorities for the conservation of biodiversity.
>
> Action 1.2.5. Rehabilitate and restore habitats and degraded ecosystems, as appropriate, as a contribution to building ecological networks, ecological corridors and/or buffer zones.

Relationship of this guide to the ecosystem approach

15. Both the introduction to the PoWPA and Target 1.2 specifically mention the use of the ecosystem approach when integrating protected areas into the wider landscape, seascape and relevant sectors. The CBD calls this approach:

> "…the primary framework for action under the Convention of Biological Diversity. The ecosystem approach provides a framework within which the relationship of protected areas to the wider landscape and seascape can be understood, and the goods and services flowing from protected areas can be valued." (CBD, 2004)

16. The ecosystem approach has 12 principles (CBD, 1998):

i. The objectives of management of land, water and living resources are a matter of societal choice.
ii. Management should be decentralized to the lowest appropriate level.
iii. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
iv. Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management program should:
    a. reduce those market distortions that adversely affect biological diversity;
    b. align incentives to promote biodiversity conservation and sustainable use; and
    c. internalize costs and benefits in the given ecosystem to the extent feasible.
v. Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target of the ecosystem approach.
vi. Ecosystems must be managed within the limits of their functioning.
vii. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

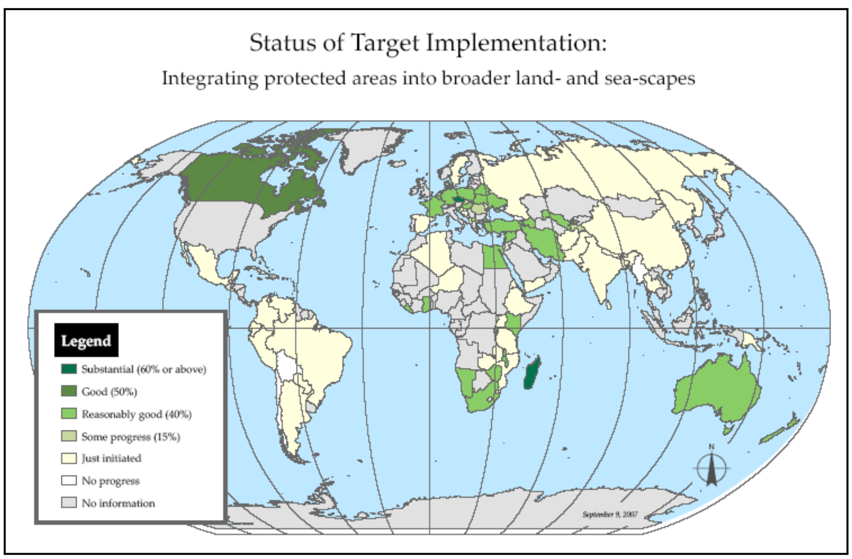
viii. Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
ix. Management must recognize that change is inevitable.
x. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
xi. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
xii. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

17. The ‘ecosystem approach’ is primarily about linking people with nature at various spatial and temporal scales. It is a framework against which the whole of the CBD can be realized. For this guide, principles five through ten are particularly relevant to linkages between protected areas and the wider landscape and seascape; principle eleven is relevant for putting ideas into practice, especially indigenous and community areas; and principle two is important when establishing management regimes.

Purpose of this guide

18. There has been much progress on the Programme of Work on Protected Areas since it was first crafted in 2004. Governments around the globe have completed ecological gap assessments, management effectiveness assessments, and are putting sustainable finance mechanisms in place. However, progress on integrating protected areas into the broader landscape, seascape and related sectors has lagged far behind (Ervin et al., 2008). Figure 2 provides a global snapshot in the progress of Target 1.2.

Figure 2: A global snapshot of the status of Target 1.2



19. This guide aims to remedy this lack of progress by providing an illustrated summary of the steps needed to achieve Target 1.2. As noted earlier, Target 1.2 includes two inter-related aspects of integration. The first part is ensuring that protected areas are integrated into an inter-connected and functional ecological network that allows for the long-term persistence of species and ecosystems. The second part is ensuring that protected areas are integrated into broader natural resource sectors and policies. While these two aspects of integration are closely related – an ecological network must consider land and water management in areas beyond protected areas, which necessitates an understanding of different sectors – in practice, most efforts at protected area integration have focused on the mechanics of creating an

ecological network, rather than on the policies and practices that affect the long-term maintenance of the network itself. This guide is an attempt to look at both aspects of protected area integration in a synergistic and complementary way, and to address all five actions in Target 1.2.

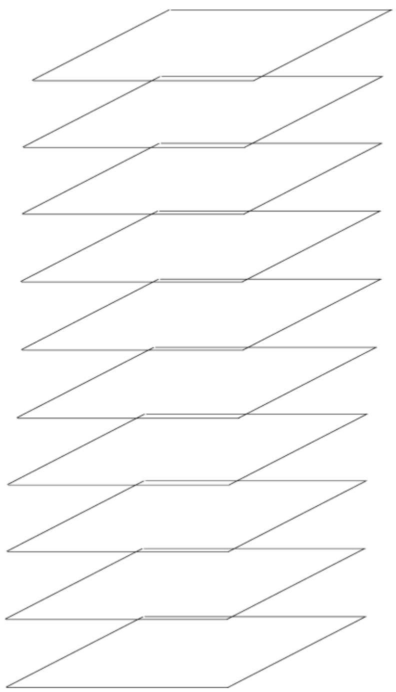
20. The concept of integrated natural resources planning across broad spatial scales is not new – one study identified over 40 different terms over the past two decades that mean essentially the same concept (Ervin, 2003b), including, for example, ecosystem-based management, integrated natural resource management, watershed-based planning, landscape-scale planning, and integrated coastal zone management. There is a wealth of literature on integrated resource planning, on designing corridors, buffers and ecological networks, and on integrating protected areas and natural resources into other sectors. The purpose of this guide is not to replicate existing literature, but rather to summarize key aspects, provide basic principles, tools and resources as they relate to an overall process of landscape integration, and to provide a coherent and systematic process for conservation planners. Resources and links for further reading are included at the end of each chapter.

21. This guide provides a step by step approach for ensuring that protected areas are integrated into the ecological network through corridors and other connectivity conservation measures, and that protected areas are also integrated into a wide range of natural resource sectors. The audience of this guide is primarily practitioners and policy makers who are responsible for the planning, design, management and evaluation of protected area networks and related policies. While the primary audience of this guide is governmental staff, it may also be useful to non-governmental, private and community managers of protected areas, as well as to the many non-governmental initiatives that are seeking to integrate protected areas into the wider landscape, such as large-scale connectivity conservation initiatives. Therefore this guide is aimed at a wide audience of conservation planners, and includes examples and guidelines that apply to a variety of governmental and non-governmental initiatives at different scales, from landscape to national to regional.

1.2 Overview of the landscape integration process

Overview of integration process

22. This guide outlines eight steps needed to integrate protected areas into the wider landscape (see Box 1 for a definition of ‘wider landscape). Figure 3 illustrates each of these steps.



Step 1: Setting a vision and getting started

Step 2: Assessing the ecological and biological landscape

Step 3: Assessing protection and conservation

Step 4: Assessing related sectors and policies

Step 5: Designing an integrated landscape

Step 6: Developing strategies

Step 7: Implementing strategies

Step 8: Monitoring status and effectiveness

Figure 3: A conceptual model of the landscape integration process – FIGURE STILL UNDER DEVELOPMENT

Box 1: Defining ‘the wider landscape’ and ‘related sectors’

Target 1.2 calls for protected areas to be integrated into ‘the wider landscape’ and related sectors. This guide uses the following definitions:

Landscape: The combination of ecosystems, plants, animals and ecological processes and abiotic features that interact within a connected and functional ecological network, and that allows for the long-term persistence of species.

Protection and conservation status: The type, distribution and effectiveness of protected areas and other types of conserved and sustainable use areas within a given area.

Related sectors and policies: The laws, policies and practices of the suite of natural resource sectors (e.g., energy, agriculture) that influence the management, use and protection of of biodiversity within and across landscapes.

Relationship with other planning processes

23. The steps in this guide are drawn from, and related to, the steps in many other conservation planning exercises. This section shows how each step relates to three of these: systematic conservation planning; ecological gap assessment; and protected area system master planning.

Relationship between a landscape integration approach and systematic conservation planning

24. Systematic conservation planning is a pragmatic approach to conservation decision making that is relevant to a wide variety of scales. It recognizes both that funding is limited, and that there are competing claims for uses of land or sea beyond biodiversity conservation (Margules and Pressey, 2000). By translating these realities into well-defined constraints and opportunities, systematic conservation planning emphasizes the efficient achievement of conservation objectives – seeking the least area or financial outlay to realize the maximum biodiversity gain. In addition to promoting efficiency in conservation investment, systematic conservation planning allows planners to allocate resources and resolve conflicts in a defensible and transparent manner. The following list shows the steps in systematic conservation planning (Margules and Pressey, 2000; Cowling and Pressey, 2003), along with the relevant chapter in this guide:

i. Setting scope and costs (section 2.1)
ii. Analyzing the situation (section 2.2)
iii. Identifying stakeholders (sections 2.1 and 2.7)
iv. Identifying and prioritizing targets and goals (section 2.2)
v. Assessing existing conservation areas (section 2.3)
vi. Identifying priority areas (section 2.5)
vii. Selecting priority interventions (section 2.6)
viii. Implementing conservation actions (section 2.7)
ix. Monitoring impact (section 2.8)

25. There is therefore an overlap with the landscape integration approach in that it involves prioritizing conservation areas. Furthermore, within a landscape integration approach, we aim to achieve landscape-scale conservation objectives efficiently; hence systematic conservation planning can be a useful tool at this scale. For example, this could mean planning at the landscape scale to achieve an efficient distribution of conservation areas as well as other land and sea uses.

Relationship between a landscape integration approach and a gap assessment process

26. Around the world, dozens of countries have completed an ecological gap assessment of their protected area systems. A gap assessment is a study that compares a country's biodiversity with the scope and breadth of the protected area system to determine biases and gaps (Dudley and Parrish, 2006). While in theory, ecological gap assessments should include gaps in connectivity, the vast majority of existing assessments do not; they focus on how well the protected area system represents the biodiversity. Furthermore, much of the guidance on conducting ecological gap assessments focus on representation and not ecological functioning and connectivity. For example, the sub-title of Closing the Gap, a CBD guide on conducting gap assessments (Dudley and Parrish, 2006), is "Creating ecologically representative protected area systems," and the guide focuses almost exclusively on assessing gaps in representativeness rather than connectivity. The typical steps in an ecological gap assessment include the following (Dudley and Parrish, 2006):

a. Identify focal biodiversity and set key targets
b. Evaluate and map the occurrence and status of biodiversity

c. Analyze and map the occurrence and status of protected areas
d. Use the information to identify gaps
e. Prioritize gaps to be filled
f. Agree on a strategy and take action

27. There is a clear relationship between an assessment of ecological gaps, which focuses primarily on biodiversity representation, and an assessment of ecological connectivity, which focuses primarily on species and ecosystem functioning. This guide is about ensuring that the gap assessment process includes issues of connectivity at each stage. It is a fundamental response that recognizes and responds to the dynamic of climate change, the reality of a dynamic environment and biome shift, and maximizes opportunities for species conservation. Therefore, each step is included in this guide, but with a specific focus on connectivity:

a. Selecting focal biodiversity and setting goals for connectivity (section 2.2)
b. Evaluating status of biodiversity relative to connectivity (section 2.2)
c. Analyzing the status of protected areas relative to connectivity (section 2.3)
d. Using the information to identify connectivity gaps (section 2.3)
e. Prioritizing connectivity gaps to be filled (section 2.5)
f. Agreeing on a strategy for connectivity and taking action (sections 2.5 and2.7)

Relationship between a landscape integration approach and protected area system master planning

28. The Program of Work on Protected Areas calls for no fewer than 20 separate assessments of a country's protected area system. Although these assessments are inter-related, governments often conduct each separately, without identifying the linkages and inter-relationships between them. In recognition of this, a recent guide published by the CBD secretariat also calls for the development of a master plan for protected area systems, one that links the various elements and assessments together (Dudley et al., 2005). The elements of a protected area system master plan include the following (Ervin, 2007):

a. A clear vision about the future of the protected area system
b. A plan to strengthen the protected area network
c. A plan to strengthen the management of each of the protected areas
d. A plan to strengthen the enabling environment surrounding protected areas
e. A plan to implement the key results of assessments
f. A plan to monitoring the status and effectiveness of the protected area system

29. This guide is about ensuring that protected area system master plans include issues of connectivity and integration in both the ecological and biological landscape and in related sectors.

a. A vision for the PA system master plan includes a vision of connectivity and integration (sections 2.1and 2.7)
b. The plan to strengthen the PA network (e.g., gap assessment, restoration) includes aspects of connectivity (section 2.3)
c. The plan to strengthen PA management includes management for connectivity inside and outside of protected areas (section 2.3)
d. The plan to strengthen the protected area enabling environment (e.g., finance, policies, sectors) includes aspects of connectivity and integration (section 2.4)
e. The implementation plan includes appropriate mechanisms that enable connectivity (section 2.7)

f. The monitoring plan includes monitoring the status of connectivity and integration, and the effectiveness of actions related to connectivity (section 2.8)

30. It is clear from the above description that the process of integrating protected areas into the wider landscape, seascape and natural resource sectors is closely related to the processes of ecological gap assessment, systematic conservation planning and protected area system master planning. The intent of this guide is not to suggest an entirely new or separate process of integrating protected areas, but rather to encourage planners to consider how they can include aspects of integration into ongoing planning processes within their own countries.

SECTION II: STEPS IN INTEGRATING PROTECTED AREAS INTO THE WIDER LANDSCAPE, SEASCAPE AND NATURAL RESOURCE SECTORS

2.1 Step 1:Getting started

Setting a vision

31. One of the first steps in integrating protected areas into the wider landscape is to have a clear vision of what an integrated ecological network could look like. A vision is an inspirational image, statement or description that provides a compelling picture for the future. There is perhaps no greater a compelling vision of landscape integration than some of the large, regional-level connectivity initiatives that have developed within the past decade (see Dudley and Rao, 2008; Ervin et al., 2008, Bennett and Molungoy, 2006). Regional-scale connectivity initiatives by their very nature provide a bold and inspiring vision. They provide a geographical focus for conservation actions, and they help planners think beyond their boundaries to a much larger conservation context (Soulé and Terborgh, 1999). More importantly, they also provide a lens through which protected area managers can understand the relationship of their particular area to the wider landscape. These initiatives may be lead by individuals, communities, NGOs or governments, and typically include many core areas within an essentially natural, inter-connected landscape.

32. But not all initiatives need to be regional or continental in scale to inspire action. Many international, national, ecoregional and focal area-scale initiatives are also inspirational, and lay out a clear vision for the future. There are hundreds of these cross-boundary connectivity initiatives around the world (Anderson and Jenkins, 2006; Ervin, 2003b). Regardless of the scope and scale of these cross-boundary initiatives, each generally starts with a clear and compelling vision.

33. When planners are beginning the process of integrating protected areas into the wider landscape, it will help to have an explicit and clear statement of the overall vision, along with supporting materials and descriptions. The vision statement ideally has the following elements if it is to serve as an effective framework for action:

a. *Summarizes the purpose of the initiative* – the statement should clarify what the initiative is, and what it is trying to achieve
b. *Includes a description of the future outcome* – the statement should describe what success would look like in the future
c. *Defines a clear geographic focus and boundaries* – what is more important than exact boundary delineation is the sense that the connectivity initiative is focused on a specific and bounded place.

If the integration process is national, than the boundaries are politically defined. If the initiative crosses boundaries, the initiative is usually circumscribed by geographical boundaries, such as the "Yukon to Yellowstone" initiative, or the Mesoamerican corridor

d. *Includes statements of governmental commitment* – in many countries, connectivity issues that do not have governmental support may face particular challenges; vision statements that include governmental endorsement and commitment to follow through are likely to have more credibility and community buy-in than those that do not.

Box 2: Example of a vision statement for a large-scale landscape integration initiative

"Our goal is to maintain and sustain this region in a way that allows wilderness, wildlife, native plants, and natural processes to function as an interconnected web of life. This is as much for the benefit of future generations as it is for the land, the wildlife, and the people currently living in the region." Yellowstone to Yukon Conservation Initiative, 2008

34. Integrating protected areas into the wider landscape can occur at many different scales. One study of over 100 cross-boundary initiatives found cases ranging from 30 hectares to over 200 million hectares (Yaffee et al., 1996). Table 1 summarizes some of the different scales for the landscape integration process, and provides a description and examples for each.

Table 1: Examples of different scales for integrating protected areas into the wider landscape (from Bennett and Mulongoy, 2006; Dudley and Rao, 2008; Ervin, 2003b)

SCALE	**EXAMPLE**	**SIZE**	**DESCRIPTION**
Focal area	Chittenden County Upland Project	500 km^2	A citizen-led initiative with partnerships between local governments, communities and NGOs to connect protected areas in Vermont, USA
Ecoregional scale	Nepal Terai Arc Ecoregion	12,500 km^2	A partnership between the government of Nepal and World Wildlife Fund to create corridors, restore degraded areas and promote sustainable development
National scale	Lithuanian Ecological Network	65,000 km^2	Governmental initiative to create an ecological network across the country
Regional scale	Mesoamerican Biological Corridor	208,000 km^2	A partnership with governments and the Central American Commission for Environment and Development to link over 350 protected areas through corridors and sustainable use areas (Miller et al., 2001)
Continental scale	Yellowstone to Yukon Initiative	1,200,000 km^2	A coalition of many actors seeking to create a continental corridor along the Rocky Mountains from Yellowstone Park in Wyoming to the Yukon in Northern Canada (Locke in Worboys et al. In Prep)

35. Each of these scales has its own inherent set of strengths and weaknesses. In general, the larger the scale, the more actors are likely to be involved, and the more politically complex the process is likely to be. At very large scales, the process of integrating protected areas into the wider landscape and related sectors will likely need to be broken up into smaller, more manageable sizes. The Yellowstone to Yukon Initiative, for example, has eight priority areas, each about the size of an ecoregion. Each of these areas in turn has several focal areas.

Identifying a planning approach

36. Planning, like any activity that is steeped in traditions and norms, can have differing interpretations and expectations depending on the social and cultural context. A planning approach that works in one country may not work in another. Even within a single country there are bound to be differing views about the planning process. The following description of five different planning approaches helps to clarify some of these differences (from Ervin, 2003b):

a. *Authority-oriented planning:* In this approach, planners view the planning process as a government-controlled exercise, based on a governmental mandate or decision, and guided by a governmentally-led vision. A government agency typically leads the process, and government planners involve those selected individuals and organizations that can provide needed expertise to fill gaps in governmental expertise. Targeted stakeholders are brought on as needed in order to implement specific strategies.

b. *Expert-oriented planning:* In this approach, planners view the planning process as a comprehensive, rational and strategic process involving relevant experts. The process is usually procedural, going step by step based on a strategic planning framework. Governmental agencies, non-profit environmental organizations, university and research bodies are typically at the core of this type of planning process. Other stakeholders, such as landowners and businesses, are engaged when they are needed to provide expert opinion, or to implement strategies.

c. *Politically-oriented planning:* In this approach, planners view the planning process as controversial, politicized and/or highly contested between different actors. The planning process typically originates outside of government, and may include government as one of many actors with different opinions and levels of influence. Stakeholders are typically very diverse, and are brought to the table as early as possible so that the team composition and process is considered politically ‘balanced’.

d. *Dialogue-oriented planning:* In this approach, planners view the planning process as an opportunity for innovation, dialogue, learning and collaboration. The emphasis is less on which political actors are engaged, and more about how the views of different stakeholders are incorporated into the planning process. Planners seek to establish consensus through discussion and dialogue, and involve stakeholders who can contribute to that discussion.

e. *Transformation-oriented planning:* In this approach (also called ‘civic environmentalism,’ ‘organic planning,’ and ‘vision-led planning,’ participants view the planning process as an opportunity to transform the existing structures, processes, scales, mechanisms and norms of planning. The emphasis of this approach is on infusing an ecological ethic into traditional planning processes, on ensuring that local communities and stakeholders are fully engaged from the beginning, and on starting from a core group of like-minded individuals. This type of planning typically involves innovative partnerships between private, public and non-profit sectors, and involves stakeholders throughout the process.

37. These five types of planning help distinguish some of the different approaches and underlying assumptions that planners and partners may bring to the table when getting started. They are not necessarily exclusive, and many initiatives may take different approaches to planning at different stages

of the connectivity initiative. However, it may be helpful in the early stages to clarify among the initial planning group what the expectations are regarding the planning approach. Clarity at this stage about what the planning process is intended to achieve, and how it will achieve those ends, will help to avoid confrontation and confusion further down the process.

Identifying and analyzing stakeholders

38. Because trans-boundary connectivity initiatives are inherently complex, and inevitably involve multiple sectors, it will be important to identify key partners and stakeholders early in the process. The nature and level of stakeholder engagement will vary depending on the scope and scale of the initiative, and on the planning approach chosen, but will usually include individuals from public, private and non-profit sectors.

39. Because the selection and engagement of stakeholders is one of the defining factors in a successful connectivity initiative, planners will need to consider not only who is involved, but also how and when they will be involved in the process. Planners should also consider the potential interests of different stakeholders, and what their outlook toward the initiative is likely to be (Anderson and Jenkins, 2006). This step, called a stakeholder analysis, will help planners be clear about how and when they can best engage stakeholders. A database of land tenures, governance types, and property owners will be helpful in such an analyis. Figure 3 provides a list of potential stakeholders to consider, and some questions that planners can use when conducting a stakeholder analysis.

Figure 3: A framework for conducting a stakeholder analysis

Stakeholder group (examples)	Interests	Likely outlook	When to involve	How to involve	Whom to involve
Public sector					
Protected area agency officials					
Protected area managers					
Forestry agency staff					
Zoning administrators					
Municipal, state, province and national planning agencies					
Transportation agency					
Wildlife agency staff					
Private sector					
Landowners					
Community leaders					
Tourist associations					
Agricultural companies					
Forestry companies					
Mining companies					
Non-profit sector					
Universities and scientists					
Community and economic development staff					
NGOs					
Community associations					

40. For example, INSERT EXAMPLE HERE

Setting parameters

41. Once planners have a clear vision, have agreed upon the planning approach, and have identified and analyzed stakeholders, they must then begin to set clear parameters on the integration process. These are likely to include:

a. *Identifying clear roles and responsibilities* – The process will need to have not only a strong leader, but also a team of individuals who are well coordinated. This means assigning clear roles and responsibilities, including, for example, assigning individuals to communicate with the public, hire staff, coordinate data gathering, publish results, track progress and manage funds.

b. *Setting a timeline* – Although it may be difficult to determine exactly how long each step may take, it will be helpful to set a goal for an end date. This may include a series of short term deadlines (e.g., collect all data by a certain date), and it may include having a timeline for achieving overall goals. The government of Palau, for example, has set a timeline of 2020 to have a functional network of marine protected areas in place, covering 20% of the near-shore environment.

c. *Setting a budget* – The cost of planning processes can vary tremendously, depending on the scope of the project. Planners should use budgetary limits to help prioritize actions. Each major action should have a cost estimate and source of funds associated with it, and there should be an overall estimate of what the initiative will cost, including both planning and implementation costs. This estimate will be subject to change, depending upon the strategies that are developed.

d. *Agreeing on scope of process* – This guide outlines a step by step process for integrating protected areas into the wider landscape. However, planners will want to review the status of other conservation planning efforts, and determine whether all or only a portion of the steps are needed.

INSERT BOX HERE ON TOP-DOWN VS. BOTTOM UP CONNECTIVITY AND INTEGRATION PLANNING

Establishing effective partnership mechanisms, structures and agreements

42. In order to implement an initiative that improves landscape integration and connectivity planners will need to form effective partnership mechanisms. These mechanisms may take a variety of forms, ranging in size, composition, and complexity. Some examples of partnership mechanisms include governmental task forces, regional advisory councils, ad hoc steering groups, international panels, community working groups, and private sector groups.

43. But nearly all collaborative initiatives will benefit from having a signed memorandum of understanding that clearly outlines the parameters, scope and breadth of the partnership. Below are some elements of a typical memorandum of understanding for a cross-boundary conservation initiative:

e. *Statement of purpose* – a summary of the purpose of the memorandum of understanding, such as working together to establish, maintain and effectively manage a comprehensive ecological network;

f. *List of signatory parties* – usually a list of the organization and the associated individuals;

g. *Nature of the agreement* – a statement that summarizes what the main activities will include, such as identifying priority areas for protection, promoting the work with donors, implementing specific responsibilities within the work plan;

h. *Timeline and termination clause* – an anticipated time horizon, and an explanation of how parties can terminate the agreement;

i. *Copyright, ownership and distribution issues* – an agreement about how intellectual property generated during the course of research will be used, attributed and distributed;

j. *Data sharing agreements and confidentiality issues* – agreements on how to share data across different data platforms and systems, and how to ensure confidentiality of sensitive or proprietary information;

k. *Use of names and logos* – an agreement on how signatories may use the logos and names of other signatory parties;

l. *Dispute resolution* – a description of how disputes and conflicts should be resolved;

m. *Funding issues* – a summary of how funds will be transferred, and how budgeting and accounting will take place;

n. *Work plan* – an appended document that specifies the roles and responsibilities of each party, including specific actions, timelines, and indicators of success.

Characteristics of early stages of successful connectivity initiatives

44. It is clear from comparisons of connectivity initiatives that they vary widely in their scope, scale, governance, composition and levels of implementation (Anderson and Jenkins, 2006; Ervin, 2003b). However, there appears to be a set of characteristics that are common to most successful cross-boundary connectivity initiatives in their early phases. These characteristics include the following (from Anderson and Jenkins, 2006; Soulé and Terborgh, 1999, Driver et al., 2003; Knight et al., 2006):

a. They have one or more strong, charismatic, visionary leaders who champion the initiative across many sectors

b. They have a clear vision with a well articulated purpose and objectives
c. They have someone who champions the initiative within the government and is well-placed to effect change
d. They have the support of local communities and community leaders
e. Have a shared understanding of the planning approach and process they will use from the beginning
f. They have effective partnership mechanisms in place
g. They have a written memorandum of understanding
h. They have clear roles and responsibilities assigned to each member
i. They engage multiple stakeholders from the beginning, including from the public, private and non-profit sectors
j. They clearly understand the interests and needs of each stakeholder group
k. They typically cross multiple political boundaries, including state, county, province, and national boundaries
l. They involve multiple economic and natural resource sectors
m. They employ a variety of strategies, and have a cohesive, integrated plan for implementing those strategies

2.2 Step 2: Assessing the ecological and biological landscape

Basic concepts and terms related to assessing the ecological landscape

45. There are many relevant concepts and fields that are applicable to creating ecologically functional landscapes; the following are four that are particularly relevant for this guide: landscape ecology, landscape connectivity, ecological network and species population dynamics (Anderson and Jenkins, 2007; Bennett, 2003). This section briefly describes each of these concepts, and defines related key terms.

46. The first general concept is that of a landscape and its structural elements, derived from the field of landscape ecology. In the context of landscape ecology, *landscapes* are generally defined as "heterogeneous areas of land or water that include clusters of interacting and repeating ecosystems" (Forman and Godron, 1986). Components of a landscape include *patches* (relatively homogenous, non-linear areas that differ from their surroundings), the *matrix* (the most extensive and connected landscape that surrounds patches), and *corridors* (strips of land or water that are similar to patches and differ from the matrix and that link patches) A *landscape mosaic* is the spatial configuration of habitats, patches, corridors and the matrix within a landscape (Forman and Godron, 1986). Note that the term 'landscape' in this guide is used to mean both landscape and seascape – a heterogeneous area including interacting and repeating coastal, near shore and deep sea ecosystems.

47. The second general concept is that of landscape connectivity. *Landscape connectivity* is a term that emerged in the early 1980s, and encompasses two related aspects. The first aspect is *structural connectivity*, which is defined as the degree to which patches are connected through corridors (Taylor et al., 2006). Structural connectivity can be measured through metrics that are independent of any particular species, and landscapes are defined in terms of their 'porosity' and 'permeability'. The second aspect is *functional connectivity*, which is defined as the degree to which the landscape configuration of the matrix, patches, and corridors enables the movement of species and the functioning of ecological processes (Tischendorf and Fahrig, 2000; Taylor et al.1993). Structural connectivity is generally easier to measure and design than functional connectivity, and the preponderance of connectivity practice and research has

focused on the former (Taylor et al., 2006). Focusing on structural connectivity may be appropriate at regional and continental scales, but for national-scale and landscape-scale initiatives, a focus on functional connectivity is more appropriate and likely to result in better conservation planning (Humphrey et al., 2005). Since the aim of this document is to provide guidance on protecting biodiversity, and the primary audience is national governments, this guide focuses mostly on functional connectivity – that is, it focuses on a specific set of focal species and ecological systems, and describes methods for assessing the extent to which the connectivity of an ecological network is adequate for sustaining those focal targets.

48. The third general concept is that of *ecological network.* The term "ecological networks" generally refers to a network of *core areas* (e.g., areas that have high viability and integrity), which are surrounded by *buffer zones* (areas of compatible land uses that serve as transitional zones) and *sustainable use areas* (areas of land and water that are managed for the sustainable use of natural resources and ecosystem services). These core areas and buffer zones are connected by a series of *corridors* (mechanisms by which species can disperse and ecological processes can occur) and/or *stepping stones* (small patches that are close enough to core areas to allow for species dispersal) across a landscape (Bennett 2003, Bennett and Mulongoy, 2006).

49. The fourth general concept is that of *species population dynamics*. This concept focuses on the maintenance of species *metapopulations* (a set of localized populations within a larger area that periodically interbreed with populations from another area), by: 1) maintaining minimum *viable population sizes* (the smallest population size that can ensure the long-term persistence of a species); 2) ensuring the protection of *source habitats* (areas that have higher average birth rates than death rates for a key species); 3) minimizing the influence of *sink populations* (areas that have higher average death rates than birth rates for a key species); and 4) buffering vulnerable species against the impacts of environmental change (Anderson and Jenkins, 2006).

Identifying focal conservation targets

50. Improving landscape connectivity is widely recognized as an important conservation strategy (Bennett, 2003; Crooks and Sanjayan, 2006). However, taking a structural connectivity approach and simply stringing together landscape patches with corridors in random patterns is insufficient for creating the kind of connectivity that will sustain species, systems and ecological processes over time. A functional connectivity approach is required, and functional connectivity cannot be defined in isolation from the species, natural systems and ecological processes that one is trying to protect (Taylor et al., 2006). Therefore, the first step in defining a connected and functional ecological network is to identify the set of focal conservation targets that the network will be designed to connect and therefore sustain.

51. A conservation target is generally defined as a feature of biodiversity on which planners focus their planning and actions in order to achieve specific conservation objectives. A focal conservation target may be a species, an ecological system or an ecological process (Groves, 2003). In many large-scale conservation planning processes, the list of conservation targets can be very long indeed. Some ecoregional plans, for example, have as many as 1,000 or more conservation targets (Benitez et al., 2006 CHECK). However, in the context of this guide, the suite of conservation targets is likely to be a much smaller list, as the emphasis is improving functional connectivity. Wildlife Conservation Society, for example, suggests that a suite of three to six species per landscape may be sufficient (WCS, 2002), and The Nature Conservancy suggests no more than eight for any specific area (CITATION).

52. Targets that are selected for the purposes of defining functional connectivity could be considered ‘connectivity targets,’ in that they include the species and ecological systems that are most vulnerable to disruptive environmental changes, such as habitat degradation, fragmentation, and the effects of climate change. Rather than serving as representative surrogates for the full suite of biodiversity, focal connectivity targets serve as surrogates for the overall degree of connectivity for a range of biodiversity across a landscape.

53. This section defines focal species and focal ecological systems, and provides guidance and examples on selecting and setting goals for each.

Selecting focal species for connectivity

54. There are a variety of different approaches one can take in the selection of focal species for connectivity. The Wildlife Conservation Society (WCS, 2002; Copollilo et al., 2003), for example, proposes the following set of five selection criteria: 1) area (including the size of the species home range, species dispersal distances, the proportion of the landscape occupied by the species); 2) the degree of habitat heterogeneity required by the species; 3) the vulnerability of the species to a variety of threats; 4) the effects the species has on ecological structures and functions within natural ecosystems (e.g., beavers, elephants); and 5) socio-economic significance – whether or not the species has particular economic or social significance.

55. Conservation International takes a different approach to selecting species; it focuses on globally threatened species (based on the IUCN Red List), and then develops key biodiversity areas within a region – areas that are of global conservation significance because they regularly support populations of globally threatened species, restricted range species, biome-restricted species and/or species that congregate (Botrill et al., 2006)

56. Kettunen et al. (2007) propose a third approach to identifying focal connectivity species. They advocate choosing those species that are particularly sensitive either to fragmentation or to climate change. Species sensitive to fragmentation are rare, have specific habitat requirements but large home ranges, limited dispersal abilities, low reproductive potential and longevity, and low colonization ability. Species vulnerable to climate change are those species that exist at the margins of temperature and precipitation gradients and the extremes of their range, are at the limit of their altitudinal distribution, have a narrowly defined niche, and have a restricted range.

57. In addition to this list of criteria for selecting landscape connectivity targets, Kettunen et al. also propose three categories of risk, based on categories of fragmentation vulnerability developed by Henle et al. (2004): 1) *highly vulnerable species* that have low natural abundance and/or high individual area requirements, high fluctuations in population, low reproductive potential, low storage effects, intermediate or low dispersal power, and specialized habitat requirements; 2) *vulnerable species* that have low population size and density, large area requirements, and high mobility, and 3) *less vulnerable species* that have high density and low population fluctuations. The authors recommend selecting a suite of focal connectivity species from each of the categories.

58. While each organization or government may have its own criteria for selecting focal connectivity species, the resulting selection of species, based upon different selection approaches and criteria, is likely

to be comparable. A study of five major NGOs, for example, compared the selection of landscape-scale species within the Samburu landscape of Kenya, and found that despite different approaches, the resulting set of species selected was very similar. All five of the organizations emphasized large, area-demanding globally-threatened mammals, and four large mammals were selected by four out of five of the organizations – Grevy's zebra, elephant, lion, and wild dog (Botrill et al., 2006). Common principles among the NGOs for species selection included species that were area-demanding, provided an 'umbrella' for many other diverse species, were vulnerable and/or irreplaceable, and contributed to the overall functioning of the ecosystem.

Selecting ecological systems for connectivity

59. Although landscape connectivity is primarily about the interactions between species and landscapes (Taylor et al., 2006), and therefore species will likely comprise the majority of focal connectivity targets, it may also be useful to consider ecological systems and related processes when designing an ecological network. In part this is because selecting only species as conservation targets may miss some aspects of connectivity that are best represented by selecting ecological systems and processes, a distinction often described as a 'fine filter' versus a 'coarse filter' approach (Groves, 2003).

60. Ecological systems are defined as assemblages of species that recur under similar environmental conditions across a landscape, are tied together by similar ecological processes such as fire or hydrology, share underlying environmental features and gradients such as soils, slope and elevation, and form a unit that is easily recognizable on the ground (Anderson et al., 1999; Groves, 2003). In selecting an ecological system or natural community as a connectivity target, planners can choose from a range of taxonomic scales. Anderson et al. provides an example of choosing a target at seven different levels, ranging from the broadest scale (e.g., conifer forest) to the most specific scale (e.g., maritime black spruce wetland conifer forest). The authors recommend that planners aim for a mid-level scale when choosing ecosystem targets (e.g., wetland conifer forest), since these are generally easier to map than very fine scale targets, but still provide enough resolution for meaningful planning.

Setting connectivity goals for species and ecological systems

61. When planning an ecological network, it is not enough simply to identify a set of focal connectivity targets. Planners must also answer one of the fundamental questions in conservation planning – how much is necessary to protect in order to ensure long-term persistence. In the context of this guide, setting clear goals for conservation means asking how much connectivity – and connectivity of *what to what* – is required to ensure that a species or ecological system persists. Setting connectivity goals not only helps planners understand the potential tradeoffs between protecting one corridor or large patch versus another, but also helps planners assess the effectiveness of the network in achieving the overall vision of protecting biodiversity (Groves et al, 2003).

62. The process of setting connectivity goals will vary depending on the selected species and the scale of the process. However, there are likely to be some commonalities across most scales and planning processes. The following is a list of general guidelines, drawn from various authors (Schaffer, 1981; Morris et al., 1999, Hilty et al., 2006, and Groves et al., 2003; Anderson et al., 1999; Conner, 1998), on setting goals in conservation planning. The list has been adapted to focus on guidelines for setting connectivity goals:

a. Identify the minimum size and connectivity of the habitat needed to sustain individuals within the population, as well as across a broader meta-population over time

b. Identify ecologically functional populations – the number and distribution of a species needed to fulfil their ecological niche within a functioning ecosystem
c. Identify connectivity needs for daily, seasonal and lifecycle movement and dispersal
d. Ensure that species are distributed across the ecological regions to which they are native, in order to safeguard against natural disasters and unforeseen environmental changes
e. Consider recommendations from national and international recovery plans when setting goals for species that are on endangered species lists (e.g., the IUCN species survival commission action plan)
f. Incorporate the results of population viability analyses – the minimum number of individuals and sub-populations needed to sustain a broader population over time – into the goals for species for both populations and meta-populations
g. Incorporate the concept of minimum dynamic area – the minimum area of an ecological system needed to ensure survival or recolonization
h. Use the results from species-area relationships (the relationship of a patch size to the density of individuals within that patch) to determine the minimum size of a habitat patch needed to sustain a focal species
i. Set higher connectivity goals for species with limited distribution and restricted ranges
j. Consider historic natural ranges of variability as a guidepost in setting connectivity goals, which may, in cases where areas have been highly degraded, include setting goals for restoration
k. Allow for a range of goals to provide more flexibility, and to allow planners to make tradeoffs between one target and the next
l. Observe the precautionary principle by including safety margins and redundancy in the goals for species and systems

Table 2: Examples of connectivity targets, their goals and rationale for selection

Site	Connectivity target	Rationale	Connectivity goal
Madison Valley (Brock et al., 2006)	Boreal toad (Bufo boreas boreas)	Highest Ranked Landscape Species (of 63), according to criteria outlined in Coppolillo et al. 2007, including areas requirement, heterogeneous use of habitats, ecological functionality, vulnerability, and socio-economic significance.	To maintain a viable meta-population (breeding activity and recruitment in at least 4 out of 10 years), where a population equals one or more breeding localities located with a 2nd or 3rd order drainage separated by no more than 5 miles).
Madison Valley (Brock et al., 2006)	Grizzly bear (Ursos arctos)	Sixteenth ranked Landscape Speces (of 63). Highly threatened, representing numerous unique threats and habitats.	To maintain connectivity that allows expansion of Grizzly bears from source population in the Madison Range and Yellowstone National Park to the Centennial and Gravelly's Ranges.
Madison Valley (Brock et al., 2006)	Wolverine (Gulo gulo)	Fifth ranked Landascape Species (of 63), and complementary to higher ranked species	To maintain a viable population that includes the Madison Valley and is connected to adjacent habitats.
Somerset landscape (Dudley and Rao, 2008)	Flooding processes, shoreline habitat	Flooding maintained a suite of processes and species, and had been severely curtailed	To restore flooding processes in order to restore viability of key species

Yukon to Yellowstone Initiative (Y2Y, 2008)	Grizzly bear (Ursos arctos)	A wide ranging species facing an array of threats and increasing habitat fragmentation and key choke points	To maintain connectivity between populations along corridors from Yukon to Yellowstone (in Worboys, 2009)
Chittenden County Upland Project (Ervin, 2003b)	Bobcat	A wide-ranging carnivore with specialized habitat requirements in an increasingly fragmented habitat	To maintain connectivity between populations in the Southern and Northern Green Mountains

63. In developing connectivity goals for a focal species, a more specific goal is generally better for developing conservation plans and monitoring effectiveness. Ideally a goal for connectivity should have a statement about:

a. The total number of occurrences across the region of interest
b. The number of individual groups or units
c. The quality of each individual group or unit (e.g., size, density).
d. How individual groups or units should be distributed in space
e. How individual groups or units should be connected (e.g., width, maximum length of corridor, and description of the structure of corridor)

64. The following are two examples of specific connectivity goals:

a. For a population of elephants in West Africa: "Conserve a total population of 5000 elephants, at 1 elephant/ 5 km2 in their wet season habitats (savanna), and 1 elephant/ 1 km2 in their dry season habitats (watering holes). To allow for movement among seasonal habitats, habitats should at minimum be connected by clear wooded corridors, at least 200 m wide and no gaps more than 200 m wide, and should not be separate by more than 10km (maximum corridor length determined by annual movement abilities)."

b. For a metapopulation of puma in Central America: "Conserve a total of 10,000 animals, including at least 6 separate populations of at least 1000 animals (minimum viable population). To be considered separate and to protect against cataclysmic events, populations should be >50 km apart, and at least 1 population should be in each of the 3 ecoregions in which the species naturally occurs. To ensure dispersal among populations, each population should be physically connected to at least 1 other population, at minimum, by a corridor of primary or secondary forest, that is at least 1 km wide, contains no gaps larger than 500m, and is no more than 200 km long (maximum dispersal distance)."

Assessing the viability and connectivity of focal targets

65. Assessing the viability of focal conservation targets is a key step in nearly all conservation planning processes (Groves, 2003; Margules and Pressey, 2000). This holds true for the process of integrating protected areas into the broader landscape, as the extent and distribution of viable populations of focal species and intact ecosystems form the cornerstone of a functioning ecological network. Species viability is defined as the extent to which a population can maintain its vigor, and maintain its ability to adapt and evolve over time (Soulé, 1987; Groves, 2003). Ecosystem integrity, a related concept, is the degree to which an ecosystem has the full range of elements, such as species, communities, structures,

and the full range of naturally occurring processes, such as biotic interactions, disturbance regimes and nutrient and energy flows (Karr and Chu, 1995; Groves, 2003).

66. In many conservation planning processes, species viability assessments focus primarily on three indicators: *size* (e.g., the population size, or size of the ecosystem patch); *condition* (e.g., the quality of the species habitat); and immediate *landscape context* (e.g., the condition of land and water surrounding the habitat patch) (Groves, 2003; WWF and TNC, 2006). They are less likely to focus on connectivity aspects in their viability analyses.

67. If there is an ongoing conservation planning process within a landscape or country, it is likely that scientists have already mapped the distribution, extent and viability of species and ecological systems. However, these analyses may not have included an assessment of the degree of connectivity for focal targets. Therefore, the following is a summary of approaches that planners can use to measure connectivity for focal species (from Fagan and Calabrese, 2006):

a. *Nearest neighbour approach:* This approach is based on standard field survey data and/or modelled data on whether or not a habitat patch is likely to be occupied by a key species, and then measures how isolated this patch is from its nearest neighbour. This approach is considered the least reliable method, but also requires the least data.

b. *Spatial pattern indices:* This approach uses remotely sensed data, and uses metrics such as number, size, extent, shape and spatial arrangement to provide an estimate of structural connectivity. The advantage of this approach is that it can be used across very large spatial scales to quickly characterize the structural connectivity, but it does not provide much information on functional connectivity.

c. *Scale-area data:* This approach uses point or grid-based data of species occurrence at one point in time, such as historical records. Based on this information, planners can then determine what percentage of a region is occupied by a particular species. The disadvantage of this approach is that historical records are typically out of date, or have inherent biases.

d. *Graph theory approaches:* This approach uses spatially explicit habitat data, combined with data on species dispersal, to identify the likely ability of a species to move through a landscape. Also known as graph theory, this approach represents a landscape as a mathematical graph, and can be used to simulate multiple scenarios by simulating the destruction of various habitat patches and measuring the potential effects on the overall model (Urban and Kitt, 2001). This approach has the advantage of easily scaling up to national and regional levels (Fagan and Calabrese, 2006).

e. *Buffer radius and incidence function models:* This approach calculates a buffer with a radius around a core area based on species dispersal information, and then measures how many occupied patches lie within that radius. Also known as an ‘incidence function model, this approach provides a very detailed level description of patch-level connectivity, but is difficult to scale up beyond a landscape scale.

f. *Actual species movement:* This approach provides the most direct estimate of actual connectivity because it tracks patterns of actual species movement through radio tracking, camera traps and mark-release methods. However, this is the most time-consuming and data-intensive approach.

68. These categories are arranged in ascending order of both information and data requirements, and of degree of detail and reliability of the resulting analyses. As Fagan and Calabrese note, there is a clear tradeoff between choosing an approach that requires less data but provides less useful information (e.g., nearest neighbour approach), and a data-intensive approach that is more robust (e.g., actual species movement data).

69. INSERT EXAMPLE OF MEASURING CONNECTIVITY FOR A FOCAL SPECIES, AND DISCUSS TRADEOFF

Optimizing connectivity for individual and multiple species

70. The next step in assessing viability and connectivity is to develop an optimally connected network for each focal conservation target, based on existing patterns and constraints in the physical landscape, and on the goals established for each target. Once planners have identified optimal connected networks for each focal conservation target, the challenge then is to combine these different networks into a single scenario – one that optimizes the network for all focal species. Figure 4 provides a conceptual example of combining several different habitats into an optimal network. This process will likely be fraught with trade-offs between one species and the next, and will likely require multiple scenarios and options for planners to discuss.

Insert Figure 4

71. There are different approaches to optimize the connectivity for multiple species, but planners are faced with two fundamental choices – to use sophisticated software based on GIS information, or to use expert opinion and best judgment. The former is faster (assuming all information is available and fully digitized), less prone to biases, more reliable, and easily generates multiple scenarios. It is also more expensive, and requires expertise in using it. Table 3 summarizes some of the software available for optimizing the connectivity for multiple species.

Table 3: Summary of software used to optimize connectivity for multiple species

Dedicated connectivity software and algorithms	**Reserve optimization software that can incorporate connectivity**
Habitat availability index (Saura and Pascual-Hortal, 2007)	RESNET (Fuller et al., 2006)
Spatial links tool (Drielsma et al., 2007)	C-PLAN (Linke et al., 2008)
LQGraph (Fuller and Sarkar, 2006)	MARXAN (Smith et al., 2008)
GIS-based multi-criteria approach (Phua and Minowa, 2005)	ZONATION (van Teeffelen and Cabeza, 2006)
Map-analysis tool (Hargrove et al., 2005)	
GIS site-selection process for habitat creation (Nikolakaki, 2004)	

72. Expert opinion, on the other hand, is readily available and inexpensive, fosters increased participation in and understanding of the process, and does not require digitized information – participants can use existing maps and overlays to make decisions. However, using solely expert opinion to optimize the connectivity of multiple species requires effective group decision making and leadership, a clear understanding of the needs of each species and the effects of different scenarios and tradeoffs, and is typically very time consuming. One of the best ways to optimize connectivity for multiple species is to generate a series of scenarios using software programs, and then use expert opinion to identify which of these are optimal.

73. INSERT EXAMPLE OF USING EXPERT OPINION TO OPTIMIZE CONNECTIVITY FOR ECOLOGICAL AND EVOLUTIONARY PROCESSES OF MULTIPLE SPECIES

Identifying gaps in connectivity

74. Regardless of the approach used to measure and optimize connectivity for a suite of different focal species, the end goal is to be able to identify and map constraints and gaps in connectivity across the physical landscape. In very few situations will there be a scenario that fully connects all focal species. There are almost always gaps and constraints. Based on the final map developed in the previous step, the next step is for planners to identify where these gaps and constraints are. These may include:

a. *Core areas that are too small for some species:* the minimum habitat size will vary from one species to the next, and either because of limitations in the physical landscape, or because of tradeoffs between different species, some core areas may be too small to sustain focal species

b. *Physical barriers to the movement of some species*: some physical barriers, such as roads and developed areas, may be more difficult to some species to overcome than others

c. *Corridors that are too long for some species:* The maximum distance that a species can travel between core patches will vary from species to species. In cases where the distance is too long, planners may consider creating nodes or small patches within the corridor.

d. *Corridors that are too narrow for some species:* Some species are more sensitive to the effects of edges than others, and may need wider corridors.

e. *Stepping stones that are too far apart for some species:* Some species can move more easily than others across inhospitable areas to stepping stones – small, isolated patches between larger patches.

Figure 5 shows a conceptual example of gaps and constraints in an optimized network.

INSERT Figure 5: example of gaps and constraints in the physical landscape

INSERT BOX ON INTEGRATING CLIMATE CHANGE ADAPTATION INTO TARGET SELECTION AND GOAL SETTING

75. Transition/concluding para

2.3 Step 3: Assessing protection and conservation status

76. The next step in designing a functional ecological network is to assess the status of protection and conservation– the extent to which lands and waters are legally protected and effectively managed. This process includes two parts. The first is assessing the status of protected areas, and the second is assessing the status of other conserved areas.

Assessing the status of protected areas

77. Assessing the status of protected areas involves several factors, including an analysis of the type, distribution and management effectiveness of the full range of protected areas across the landscape. Protected areas are defined as:

> "A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (IUCN, 2008)

78. Protected areas can range in size from tiny sites of no more than a few hectares, to giant swaths of land or water hundreds of square norkellin in size. They can have a range of objectives, governance arrangements and management regimes. The most common system for categorizing the wide range of protected areas is the system of categories put forth by IUCN (2003):

Ia	Protected area managed mainly for science of for wilderness protection
Ib	Protected area managed mainly for wilderness protection
II	Protected area managed mainly for ecosystem protection and recreation
III	Protected area managed mainly for conservation of specific natural features
IV	Protected area managed mainly for conservation through management intervention
V	Protected area managed mainly for landscape/seascape conservation or recreation
VI	Protected area managed mainly for the sustainable use of nature resources

79. Protected areas also vary widely in their governance arrangements. The most common system for categorizing governance types is the system proposed by Borrini-Feyerabend in Lockwood et al., 2006:

Type	**Description**
Government management	Protected area managed by national or local government, occasionally through an officially appointed independent body
Co-management or collaborative management	Involving local communities in management through consultation and through sharing and/or management responsibility to communities or NGOs)
Community-conserved areas	Voluntary conservation by indigenous, mobile and local communities
Private protected areas	Protected areas managed by private individuals, companies or trusts

Using IUCN and governance categories in assessing protection status

80. The IUCN categories and the governance types can be a useful tool when mapping and assessing protection status by indicating the degree of protection likely to occur within each protected area, and the configuration of that area relative to the ecological landscape. For example, Figure 6 below summarizes the protected area categories, and then shows the spatial configuration of this information relative to an ecological network on the right hand side. Planners can use this information to identify connectivity gaps in protection.

INSERT FIGURE 6 SHOWING TABLE AND MAPS

Assessing protected area management effectiveness

81. Similarly, data on protected area management effectiveness can be useful in the connectivity planning process. The issue of protected area management effectiveness has gained considerable attention over the past decade, and there are numerous methodologies, guides, case studies and summary analyses that are widely available (see Hockings et al., 2006). Over 70 countries have completed an assessment of management effectiveness on at least a portion of their protected areas (see www.unep-wcmc.org/wdpa/me for a summary of these assessments). Nearly all assessments of protected area management effectiveness contain a common set of core elements that include the following elements (Hockings et al., 2006):

Table 4: Elements of protected area management effectiveness

ELEMENT	DESCRIPTION	SAMPLE INDICATORS
Context	Assessment of threats, policy environment	➢ Threats (poaching, logging ➢ Policy environment (
Planning	Assessment of protected area design and planning	➢ Protected area design (configuration) ➢ Management plan ➢ Legal status ➢ Boundary delineation
Inputs	Assessment of resources needed to carry out management	➢ Staffing ➢ Equipment ➢ Infrastructure
Processes	Assessment of the way in which management is conducted	➢ Decision making processes ➢ Research and evaluation ➢ Adaptive management
Outputs	Assessment of the implementation of management programs and actions; delivery of products and services	➢ Number of community members involved in planning ➢ Kilometers of trails maintained ➢ Number of monitoring patrols
Outcomes	Assessment of the results of management actions and the extent to which they achieved objectives	➢ Ecological results of site restoration and habitat management

82. This set of elements and their respective indicators is useful because it allows planners to pinpoint the strengths, weaknesses and threats within protected areas. Despite the considerable advances made in assessing protected area management effectiveness, few such studies have explicitly included issues related to physical connectivity. A notable exception is an assessment of protected areas in KwaZulu Natal, which identified protected area isolation and lack of landscape linkages as one of the key threats

(Goodman, 2003). For the most part, however, issues of connectivity are not included in a protected area management effectiveness assessment.

83. In order to encourage planners to explicitly include connectivity issues in future assessment of management effectiveness, the table offers indicators that could be incorporated into a management effectiveness assessment:

INSERT TABLE 4

Using PA management effectiveness data in assessing protection status

84. Data on protected area management effectiveness can be used to identify where management of protected areas may not provide adequate protection to key focal biodiversity targets. Figure 7 shows an example of how management effectiveness data can be expressed spatially. This information can also help when developing and prioritizing places for increased protection and strategies for improving connectivity.

INSERT FIGURE 7 HERE with MAP of PAME

Assessing and measuring other conserved areas and sustainable use areas

85. Legally or other effectively designated protected areas are a critical component of an effective ecological network, as they often form the large core areas that species need to persist over time. And most planning processes focus exclusively on legal protected areas (Ashley and Jenkins, 2006), without considering other alternatives. However, lands and waters that are not part of a legally-designated protected area may also provide significant ecological benefits. These areas are sometimes called "other conserved areas" or "sustainable use areas," and may have incentives and other mechanisms in place to ensure that they provide at least some assurance of long-term biodiversity protection. And while they may not provide adequate protection for all conservation targets they can, in many cases, facilitate the maintenance of connectivity at a landscape scale.

86. There are many types of other conserved areas that can contribute to an ecological network. Table 5 summarizes some of these (Dudley and Parrish, 2005, Stolton and Dudley, 2005):

Table 5: Examples of types of other conserved areas (REVIEW AND EDIT)

Type	**Sustainable use strategy (selection)**
1. Management Type: Agriculture	
✓ Legally-established system	Agrochemical control
✓ Third party certification	Organic certification
✓ Second party certification	Self assessment schemes
✓ Voluntary agreements	Agreements
2. Management Type: Forest management	
✓ Legally-established system	Forest reserves
✓ Third party certification	Forest Stewardship Council
✓ Second party certification	ISO-14000 forest standards
✓ Voluntary agreements	Codes of practice
3. Management Type: Marine fishing	
✓ Legally-established system	Government no-take zones
✓ Third party certification	Marine Stewardship Council

Type	Sustainable use strategy (selection)
✓ Second party certification	ISO certification for fisheries
✓ Voluntary agreements	Community no-take, codes
4. Management Type: Freshwater fishing	
✓ Legally-established system	Fish management areas
✓ Third party certification	Organic aquaculture certification
✓ Second party certification	ISO certification for fisheries
✓ Voluntary agreements	Voluntary landowner agreement
5. Management Type: Ecosystem services	
✓ Legally-established system	Avalanche control
✓ Third party certification	Forest managed for water quality
✓ Second party certification	ISO 1400 certification
✓ Voluntary agreements	Retention of mangroves for fish
6. Management Type: Hunting	
✓ Legally-established system	Hunting reserves
✓ Second party certification	Bushmeat controls
✓ Voluntary agreements	For-profit hunting reserves
7. Management Type: Wildlife protection outside protected areas	
✓ Legally-established system	Protection of endangered species
✓ Voluntary agreements	Private protected areas
8. Management Type: Cultural protection	
✓ Legally-established system	Cultural site with biodiversity
✓ Voluntary agreements	Sacred sites
9. Management Type: Recreation / tourism	
✓ Legally-established system	Recreational park with wildlife
✓ Third party certification	Certification of eco-lodges
✓ Second party certification	ISO certificates for eco-lodges
✓ Voluntary agreements	Protection of breeding sites

87. One of the challenges of using other conserved areas is that, unlike legally designated protected areas which generally fall into the well-established IUCN categories, there is no commonly agreed upon classification system of other conserved areas. Stolton and Dudley, however, offer A system for measuring the contribution of other conserved areas, and this system can easily be applied to assessing their contribution to connectivity. The five parameters for measuring other conserved areas include:

a. *Biodiversity value:* the overall benefit to biodiversity on and off the sustainable use area

b. *Biodiversity planning instruments:* the extent to which biodiversity conservation is a conscious strategy of the biodiversity-compatible management system

c. *Amount of modification:* the extent to which the natural ecology is changed (i.e. distinguishing between uses that maintain relatively natural systems and those that convert to cultural systems with biodiversity value)

d. *Permanence:* the length of time the area is likely to be conserved, ranging from short-term to probable long term.

e. *Social sustainability:* the degree to which the area contributes to human wellbeing.

Further reading, references and linkages on sectoral and policy integration

2.4 Step 4: Assessing related sectors and policies

Overview of related sectors and policies

88. As discussed earlier, integrating protected areas into the wider landscape entails not only developing strategies to integrate protected areas into the physical landscape, but also into related sectors and policies that have an impact on the physical landscape. Several authors have advocated that an analysis of, and strategies for, integrating sectors and policies must be an integral component of any process that seeks to design an ecological network and to integrate protected areas into the physical landscape (Ashley and Jenkins, 2006, Kettunen, 2007, Angelstam et al., 2003). Yet one author describes the policy and sectoral terrain as "a complex, messy zone of competing and cooperating social and political actors making demands on the available natural resources" (Cline-Cole, 2001). This chapter seeks to clarify this messy zone, and tease apart the many different sectors and policies that may have a bearing in the integration of protected areas into wider policies.

89. A sector is any activity that contributes to the economy of a community or country, and that has an actual or potential bearing on the effectiveness of an ecological network. Examples include agriculture, fisheries and ecotourism. Related sectors are therefore the suite of natural resource sectors that have an impact, positively or negatively, upon the design and/or implementation of an ecological network.

90. In its broadest sense, a natural resource policy is a guiding principle or course of action intended to influence an outcome related to the management of natural resources. This guide also includes as part of the definition of policy the *policy environment* – the procedures, norms and belief systems that form the context to natural resource policies that are created. Examples of natural resource policies and the broader policy environment include land use planning laws, national leadership and law enforcement practices. Related policies are therefore the suite of natural resource policies and the broader policy environment that have an impact, positively or negatively, upon the design and/or implementation of an ecological network.

91. Although sectors and policies are conceptually distinct, in practice they are integrally related – each sector has its own laws, policies and policy environment. Therefore, this chapter merges the assessment of both sectors and policies into a single step. This step will reveal the set of constraints and opportunities for integrating protected areas into an ecological network, constraints which will be critical to address when designing appropriate strategies.

Defining related sectors and policies

92. There are a number of sectors, policies and policy environment factors that will need to be included in the process of integrating protected areas into the landscape. Below are some examples of sectoral and policy issues that can be considered when assessing sectors and policies, along with a few indicative indicators. This list is drawn from a group of commonly recognized threats to biodiversity (CMP, 2006; Leverington, 2007), and from a list of policy issues that are considered relevant to protected areas (Petersen and Huntley, 2005; Ervin, 2003b and 2007).

A. *Urbanization and development:* This sector includes residential development (including cities, towns, settlements) and/or commercial development (stores, factories, warehouses, commercial centers). Possible indicators include:
   i. There are appropriate land use policies in place.
   ii. Buffer zones are designated and effectively enforced.

B. *Transportation:* This sector includes long and generally narrow corridors and the vehicles that use them, including roads and railroads, utility and service lines, shipping lanes and flight paths. Possible indicators include:
   i. Transportation agencies include considerations of connectivity when assessing options for building new roads.
   ii. There are measures in place (e.g., wildlife overpasses and underpasses) to mitigate critical wildlife crossing areas.

C. *Energy:* This sector includes the exploration and production and related infrastructure of energy resources, including oil and gas drilling, mining and quarrying of minerals, coal and other materials, and the utilization of hydro-electricity, wind power, tidal power, and solar power, among others. Possible indicators include:
   i. There are clear policies regarding the exploration and mining of oil, gas and minerals within protected areas.
   ii. There are measures to mitigate the impact of energy exploration and utilization across the landscape, such as biodiversity offsets

D. *Tourism:* This sector includes policies, practices and related infrastructure (such as huts, lodges, hotels, trails) associated with recreation and tourism, including golf, skiing, hiking, camping, norkelling, and boating among many other forms of recreation. Possible indicators include:
   i. The siting of tourism infrastructure, such as (e.g., trails, ski areas, lodges) does not conflict with areas of key importance for connectivity
   ii. Members of the eco-tourism industry (e.g., hotel managers, guides) understand issues related to connectivity

E. *Wildlife:* This sector includes consumptive uses of wild plants and animals, including animal hunting and trapping and plant collection. This includes policies, as well as both legal and illegal practices. Possible indicators include:
   i. Wildlife management policies

F. *Agriculture and grazing:* This sector includes activities related to the cultivation of annual and perennial crops, and livestock grazing. Possible indicators include:
   i. Farms and ranches include areas of natural vegetation as corridors when and where appropriate

G. *Forestry and agro-forestry:* This sector includes the management of forested lands for timber, the establishment and management of plantations and lands managed for agro-forestry. This sector includes illegal logging. In assessing this sector, planners should also consider fire management practices and policies within forests. Possible indicators include:
   i. INSERT HERE

H. *Fisheries and aquaculture:* This sector includes activities related to deep sea, near shore and inland fishing, and the cultivation of fish and other aquatic species through aquaculture. Possible indicators include:

i. Aquacultural practices, including their location and management, do not negatively impact key species within protected areas or corridors.

I. *Freshwater resources management:* This sector includes the suite of laws, policies and actions associated with rivers, streams, lakes, ponds and other freshwater bodies. Included in this sector is dam construction, flow management, and allocation of water resources. Possible indicators include:

i. Rivers, streams and other freshwater bodies are managed to maintain connectivity for key freshwater species (e.g., fish ladders) and related processes (e.g., flooding)

J. *Waste management:* This sector includes the laws, policies and practices related to waste generation and disposal from other sectors, including solid waste from municipalities, industrial waste from industrial centers, and other forms of waste and pollution. Possible indicators include:

i. The siting and configuration of waste management areas (e.g., sewage treatments, landfills) does not conflict with key connectivity areas.

K. *Invasive species management:* This aspect of policy environment relates to policies and practices related to the management of invasive plants and animals across many sectors (e.g., forestry, agriculture, tourism). Possible indicators include:

i. National policies for invasive species explicitly recognize the inherent vulnerability of protected areas to invasive species, and the potential risks of corridors as a pathway for invasive species..

ii. Efforts to eradicate and control invasive species focus on areas of high risk and vulnerability that could affect the ecological network.

L. *Climate change:* This aspect of policy environment relates to the national policies and practices that relate to climate change adaptation and mitigation. Possible indicators include:

i. National climate change adaptation plans and policies include measures to ensure connectivity for focal species

M. *Legal and judiciary environment:* This aspect of policy environment includes not only local and national-level law enforcement, but also the court systems through which laws are upheld, from prosecution through to sentencing. Possible indicators include:

i. Law enforcement policies and practices are sufficient for the establishment, management and long-term security of protected areas and corridors

N. *Inter-sectoral communication and coordination:* This aspect of policy environment relates to the degree to which agencies and sectors communicate and develop coordinated natural resource plans, including those related to the formation of an ecological network. Possible indicators include:

i. The level of communication and coordination between key agencies and natural resource sectors is sufficient

Identifying constraints and opportunities to integrating protected areas into sectors and policies

93. The first step in assessing related sectors and policies is to identify which issues are constraints and which issues are opportunities in creating a functional ecological network. However, planners must first consider what aspects of the network these issues are constraining, and which opportunities they are creating. There are two categories of constraints and opportunities. The first category includes the

components of the ecological network: protected areas, other conserved areas/sustainable use areas, buffer zones, and corridors. These are the physical lands and waters that comprise the ecological network. The second category includes the impacts that the various sectors might have on these areas. These impacts include: the creation of new areas, the maintenance of the legal status of existing areas, the maintenance of viability and ecological integrity within the areas, and the effective management of the areas.

94. These two dimensions provide us with 16 different types of constraints and opportunities. We can then combine these types with the different sectoral and policy aspects, to create a matrix that allows us to identify which aspects of the sectoral and policy environment are providing constraints and opportunities to the development, maintenance and effective management of a functional ecological network (Figure 8).

Figure 8: Identifying policy and sectoral constraints and opportunities

	Actions															
	Creation of new areas and corridors				**Maintaining legal status**				**Maintaining ecological integrity**				**Effectively managing**			
Natural resource sectors and policy environment elements	Protected areas	Other conserved areas	Buffer zones	Connectivity corridors	Protected areas	Other conserved areas	Buffer zones	Connectivity corridors	Protected areas	Other conserved areas	Buffer zones	Connectivity corridors	Protected areas	Other conserved areas	Buffer zones	Connectivity corridors
Urbanization																
Transportation																
Energy																
Tourism																
Wildlife management																
Agriculture & grazing																
Forestry																
Fisheries																
Freshwater resources																
Waste management																
Invasive species																
Climate change																
Legal environment																
Sectoral coordination																

95. For example, in the matrix above, planners may discover TEXT HERE, EXAMPLE

Mapping policy and sectoral constraints and opportunities

96. Identifying the policy and sectoral constraints and opportunities is the first step, but that alone is insufficient. Planners must also identify specific places where these constraints and opportunities are occurring. The next step, therefore, is to create a spatial map of the key sectoral and policy constraints and opportunities. Figure 9 shows an example of what such a map might look like at a landscape scale.

INSERT HERE Figure 9

97. *Further reading, references and linkages on sectoral and policy integration*

2.5 Step 5: Designing an integrated landscape

98. The three previous steps focused on assessing the ecological and biological landscape, assessing the protection and conservation status, and assessing related policies and sectors. Each of these steps will result in a different set of gaps, constraints and opportunities. The next step, designing an integrated landscape, is about combining these different sets of information in order to identify and prioritize the most important gaps, constraints and opportunities, and to develop a comprehensive vision for what an integrated landscape might look like. It is from this step that the strategies and work plan will be developed.

Identifying where gaps in connectivity align with protection opportunities

99. The first step in designing an integrated landscape is to identify areas where there is an alignment of physical connectivity gaps with protection opportunities. This step is relatively straight forward and does not require software or complicated procedures. A group of experts and stakeholders can simply examine the three maps to identify areas where the connectivity gaps and protection opportunities line up (see Figure 9).

Figure 9: Alignment of connectivity gaps and protection opportunities

100. INSERT EXAMPLE OF ALIGNMENT BETWEEN CONNECTIVITY GAP AND PROTECTION OPPORTUNITY

Identifying where connectivity gaps and sectoral opportunities are aligned

101. The second step is to identify areas where there is an alignment of physical connectivity gaps with sectoral opportunities. This step is slightly more difficult than the alignment with protection opportunities in that it requires not only a visual comparison of gaps and opportunities, but also a deeper understanding of the various impacts of each sector, and how the opportunities can be used to fill connectivity gaps (see Figure 10)

Figure 10: Alignment of connectivity gaps and sectoral opportunities

102. INSERT EXAMPLE OF ALIGNMENT BETWEEN CONNECTIVITY GAP AND SECTORAL OPPORTUNITY (study in Kavango-Zambezi TFCA from Keith Lawrence)

Identifying where connectivity gaps and protection gaps conflict

103. The third step is to identify areas where there are major barriers and constraints to addressing gaps through connectivity through protection measures. These are areas where changing the status of protection, either through the creation of a new protected area, a change in designation in category, a change in configuration, or a change in management, is unlikely to address connectivity gaps.

Figure 11: Where connectivity gaps and protection proposals conflict

104. INSERT EXAMPLE OF WHERE CONNECTIVITY GAPS AND PROTECTION GAPS ARE IRRECONCILABLE

Identifying where connectivity gaps and sectoral constraints conflict

105. The fourth step is to identify where there are major barriers and constraints to addressing connectivity gaps through sectoral and policy measures. Just as with the previous step, this step focuses on identifying areas where changing sectoral practices and policies are unlikely to address connectivity gaps (see Figure 12).

Figure 12: Where connectivity gaps and sectoral constraints conflict (COMBINE FIGURES 11 AND 12?)

106. INSERT EXAMPLE OF WHERE CONNECTIVITY GAPS AND PROTECTION GAPS ARE IRRECONCILABLE

Prioritizing areas

107. The next step in the process of designing an integrated landscape is to prioritize all of the areas where there is a clear opportunity to address connectivity gaps through either protection or sectoral changes. This again does not need software or complicated procedures, but does require that planners systematically assess which of the areas are most important to address first. Below are some questions that planners could use to help prioritize key areas:

a. Which areas are most vulnerable to threats

b. Which areas are most critical to specific focal species

c. Which areas are most critical to a number of focal species

Designing and communicating an integrated landscape

108. The final step is simply to develop a clear vision of what the integrated landscape would look like if the major protection gaps and sectoral constraints were removed to allow for a fully functioning, well-connected ecological network. This map will ideally show the existing network of protected and conserved areas, corridors and buffers, along with a vision of a protected area network in the future that is more fully integrated into the physical landscape and related sectors (see Figure 13).

Figure 13: Conceptual design of an integrated landscape

109. INSERT EXAMPLE OF AN INTEGRATED LANDSCAPE

(Example of designing a biosphere reserve for the Pantanal in Brazil that includes the design of core, buffer and corridor areas and compares the use of software and expert drive scenarios – E. Game)

110. This step will be critical for summarizing the results of the previous assessments, for developing strategies, and for measuring success. But equally important, it will be an important tool for communicating with a wide array of stakeholders, including local community members, politicians, the public and the media. Below are some elements of an integrated landscape design that planners should consider when communicating their vision of an integrated landscape:

A vision statement (MORE DETAIL HERE)

A summary of focal conservation species

A series of maps

A description of the process

111. Concluding para

2.6 Step 6: Developing strategies

Identifying strategies

112. The previous step of designing an integrated landscape will generate a set of priority areas for improving integration and connectivity of the protected area network. These prioritized areas should be the starting point for developing specific strategies, and the nature of the alignment between the connectivity gaps and the protection and sectoral opportunities will suggest specific kinds of strategies. The exact strategies that planners can employ are endless in their variety, but they generally fall into one of seven categories, including:

A. Changing the level of protection
B. Changing management practices
C. Changing laws and policies
D. Changing market incentives, distortions and externalities
E. Changing sectoral practices and policies
F. Changing the enabling environment
G. Changing the physical environment

2. *Changing protection levels*

Strategies to change protection levels may mean creating new protected areas, fostering the creation of other conserved areas, and/or creating new corridors and buffer zones. Some of the core areas may be strict wilderness areas; while others are likely to span the full gamut of IUCN categories and governance types, including community conserved areas, indigenous reserves and protected landscapes. Strategies in this category therefore include expanding existing protected areas and other conserved areas, reconfiguring them to better protect key habitats and linkages, and changing the designation to a stricter form of protection.

B. *Changing management practices*

Strategies to change management practices include managing species within protected areas to improve connectivity, improving habitat, and/or improving ecological functions and processes. Management is likely to occur within protected areas, other conserved areas, buffer zones and/or corridors. Specific strategies to change management practices include, for example, improved forest management through voluntary best practices, through certification, and through logger education.

C. *Change laws and policies*

Strategies to change laws and policies include, for example, changes to policies relating to any of the sectors relating to natural resources (e.g., land use planning, invasive species), as well as specific protected area laws and policies. This set of strategies may also entail the creation of new laws and policies (e.g., a new land tenure law), and the elimination of inappropriate laws and policies, such as perverse incentives and conflicting land tenure laws. This strategy also includes the creation of voluntary best practices, such as riparian zone management practices in agriculture and forestry.

D. *Change market incentives, distortions and externalities*

Strategies to change market incentives include the creation of market-based incentives to improve management, such as promoting green taxes and subsidies (and removing subsidies on fishing and agriculture that promote environmentally destructive practices); internalizing externalities; payments for ecosystem services schemes whereby ecosystem managers are rewarded for sustainable management; carbon trading and REDD; transferable quota schemes such as those used in some fisheries; conservation agreements; certification of forests (e.g., Forest Stewardship Council); fisheries (e.g., Marine Stewardship Council,) and agriculture (e.g., IFOAM-accredited certification); and voluntary incentives such as the creation of biodiversity offsets.

E. *Changing sectoral practices*

Strategies to change sectoral practices are as varied as the relevant sectors themselves. These may include, for example, strategies to foster appropriate site and configuration of infrastructure (e.g., mining operations, roads, intensive forest plantations), as well as strategies to discourage negative policies and practices within natural resource sectors (e.g., discourage heavy pesticide use near key freshwater areas).

F. *Changing the enabling environment*

Strategies to change the enabling environment include improving national leadership, improving coordination and communication among sectors, improving the legal and judiciary environment, especially enforcement, and promoting public awareness.

2. *Changing the physical environment*

Strategies to change the physical environment primarily include strategies to restore species and habitats.

Screening and prioritizing strategies

113. Once planners identify the full suite of potential strategies needed to implement the integrated landscape design, they must then screen and prioritize these strategies. This step entails asking a suite of questions to narrow down the most effective and efficient strategies. Planners may consider the following questions to help in this task:

a. Is the strategy effective in achieving the conservation goals
b. Is the strategy financially feasible
c. Is the strategy efficient
d. Is the strategy politically feasible
e. Is the strategy easy to implement with given resources
f. Will the strategy help to gain momentum

g. Does the strategy provide a new, replicable model
h. Will the strategy improve social benefits and human well-being
i. Is the strategy critical for success in a high-priority area

114. INSERT EXAMPLE OF POTENTIAL STRATEGIES WITH SCREENING FILTERS

Prioritizing top strategies

115. Based on the answers to the questions above, planners will want to narrow the list of potential strategies down to a select few that will achieve the largest gains quickly. MORE HERE, CONCLUDING PARA

2.7 Step 7: Implementing strategies

116. Once planners have identified, screened and prioritized the suite of strategies that will be needed in order to integrate protected areas into the wider landscape, they will then need to develop a plan to implement those strategies. This chapter has two sections; the first outlines steps in developing an implementation plan, and the second outlines an approach for mainstreaming these strategies into various natural resource sectors.

117. Developing a strategic implementation plan *INSERT HERE – TO BE DEVELOPED*

Mainstreaming strategies into natural resource sectors

118. The term ‘mainstreaming’ is a concept increasing used by development and aid agencies. Although there is no universally agreed upon definition, the following definition appears to be supported by several authors: The internalization of the goals inherent in biodiversity conservation and sustainable use of biological resources into economic and development sectors, policies and programs, such that they become an integral part of their functioning (Petersen and Huntley, 2005; Sandwith, 2002).

119. The characteristics of both a ‘mainstreaming approach’” and an ‘ecosystems services approach’ include the following (Petersen and Huntley, 2005; Sandwith, 2002, Ranganathan et al., 2008):

a. The infusion of biodiversity and biological resource use considerations into natural resource sectors;
b. The attempt to achieve gains in biodiversity while also providing social and economic benefits;
c. The infusion of biodiversity and conservation values into broad economic sectors, including forestry, invasive species, mining, tourism, energy, infrastructure development, transportation;
d. The infusion of biodiversity and conservation values into the broader enabling policy environment, including policies and legislation, land-use planning, financial incentives, education and research;
e. The inclusion of a wide variety of tools, strategies and approaches to achieve a specific goal; and
f. The incorporation of a broad array of actors, with a wide range of partnership mechanisms and agreements.

120. It is clear that mainstreaming is an approach that seeks 'win-win' solutions. Table X shows three examples of mainstreaming biodiversity concerns into natural resource sectors, and the specific strategies used for each.

Table X: Examples of mainstreaming biodiversity into natural resource sectors

Agriculture (McNeely, 2005)	**Wildlife (Goodman et al., 2002)**	**Energy (Kapila, 2002; EBI, 2002; Kiesecker, 2007)**
• Maintain natural habitats within productive landscapes • Use economic incentives to encourage farmers to conserve wild biodiversity • Compensate farmers for economic damage from wild species • Recognize property rights of farmers and indigenous communities • Use market instruments to promote sustainable agriculture • Educate landowners about sustainable practices	• Develop game ranchers association to represent interests • Create a legal framework that supports ownership of private land and of wildlife • Provide technical support to ranchers • Provide financial incentives for creating private game ranches • Use sales from game reserves to fund conservation within protected areas • Encourage ecotourism to private game reserves • Remove physical barriers (i.e., fences) between game reserves and protected areas	• Share information on the location of sites with high biodiversity value • Encourage energy companies to develop a voluntary biodiversity offset program • Incorporate connectivity and biodiversity conservation issues into the strategic environmental assessment and environmental impact assessment • Form partnerships with conservation scientists to measure and mitigate impacts

Steps to using a mainstreaming approach to implement strategies

121. While there is no prescribed set of steps to using a mainstreaming approach, the steps below may be helpful either as individual steps or as a sequential process:

a. Form direct partnerships between stakeholders interested in biodiversity conservation issues and those interested in development issues

b. Explicitly identify interests of key stakeholders

c. Identify agreed upon mutually beneficial outcomes

d. Identify conflicts and trade-offs, and work towards mutually acceptable solutions

e. Identify subsidiary strategies that serve mutually beneficial interests and achieve mutually beneficial outcomes

f. Embed and institutionalize subsidiary strategies in institutions, policies, agreements, programs and mechanisms

122. Concluding paragraph

2.8 Step 8: Monitoring status and effectiveness – TO BE DEVELOPED

123. Planners face an array of problems and challenges in developing a monitoring program for large-scale conservation initiatives. Many monitoring programs suffer from models that are not founded in ecological theory, unclear logic in selecting indicators, absence of triggers for management interventions and policy responses, inadequate connection between monitoring results and decision making, insufficient funding and inadequate implementation (Noon, DATE). Even if planners overcome avoid these problems, they still face a range of challenges.

124. Challenges to scientists and practitioners include an inadequate understanding of historical reference conditions, temporal lag times between action and outcomes, unpredictable and non-linear thresholds, cascading effects, short-term data errors and incomplete and biased data sets (Trexler and Busch, DATE). Challenges to decision makers include difficulties working at large spatial scales and crossing administrative boundaries, in developing and maintaining data systems, in integrating data from multiple sources with different protocols, and in choosing from a myriad of potential indicators (Noon, DATE; Trexler and Bauscher, DATE). Even simple monitoring programs with a small set of indicators that provide direct and timely information to decision makers are rare.

125. Because of these challenges, many projects and programs have neglected to develop or implement monitoring plans. For example, a survey of more than 37,000 river restoration projects, costing over $14 billion dollars, found that less than ten percent had any monitoring or evaluation plans at all (Bernhardt et al., 2005).

126. Yet monitoring is a critical component of any conservation initiative, including large-scale connectivity and integration processes. It increases accountability, credibility and transparency, and promotes learning and adaptive management (TNC, DATE). Equally important for large-scale conservation initiatives, monitoring can provide planners with an early warning for when interventions may be needed to prevent irreversible biodiversity losses (Noon, DATE).

Difference between status monitoring and effectiveness monitoring

127. This chapter provides a framework for developing a plan for monitoring wide-scale conservation initiatives. There are two basic types of monitoring – status monitoring and effectiveness monitoring (Deangelis et al., DATE, TNC, DATE). The first, status monitoring, asks the question "What is the status and trend of biodiversity independent of our actions" (TNC, DATE). Status monitoring includes three aspects: 1) monitoring status – the value of an indicator at a single point in time; 2) monitoring baseline conditions – the value of an indicator at a point in time other than the present to set a reference or benchmark condition; and 3) monitoring trends – the change of the value of an indicator over time (Busch and Trexler, DATE).

128. INSERT EXAMPLE OF STATUS, BASELINE CONDITIONS AND TRENDS FOR CONNECTIVITY INITIATIVE

129. The second type, strategy effectiveness monitoring, asks the question "Are our conservation actions achieving the desired results" (TNC, DATE). This type of monitoring generally relies upon a clear model that includes a specific strategy, an expected outcome from that strategy, and a desired impact from one or more outcomes (FOS, 2007). These three components link to form a 'results chain,' or a conceptual scheme of cause and effect between strategy, outcome and impact. Such a model provides a transparent and explicit model for developing specific monitoring indicators (see Figure X).

INSERT FIGURE X: EXAMPLE OF 'RESULTS CHAIN' FOR MONITORING STRATEGY EFFECTIVENESS FOR CONNECTIVITY INITIATIVE

Steps to developing a monitoring plan for connectivity initiatives

130. The following are steps to developing an effective monitoring program for connectivity initiatives (from Noon, 2003; DeAngelis, et al.,2003; TNC, 2007; FOS, 2007):

a. ***Clarify objectives*** – In the absence of clear objectives, there is little basis upon which to design a monitoring program (Legg and Nagy, 2006). A clear objective clearly specifies the desired condition or outcome. This may be based on historical reference conditions, on benchmarks set in a pristine habitat, on inherent thresholds of the species or ecosystem, such as acceptable degree of variation, or simply on expert opinion about what is sufficient.
b. ***Select indicators*** – An indicator is a measurable attribute that characterizes the status of some component of biodiversity and/or environmental quality. Good indicators are accurate and reliable, easily measurable, and cost-effective.
c. ***Select methods*** – For each indicator there will need to be a method for collecting information. The method will depend on the indicator, and available resources.
d. ***Develop an implementation work plan*** – A work plan should identify what will be monitored and why, which indicators are highest priority, who will conduct the monitoring, when it will take place, how it will be implemented, how much it will cost, who will use the information and how they will use it.
e. ***Gather data*** – This step may include gathering data on status and trends, as well as on the effectiveness of strategies. It also includes the development of a robust system for capturing data and tracking it over time.
f. ***Develop thresholds for intervention*** – The primary purpose of monitoring is to be able to adaptively manage. To be effective in achieving this goal, a monitoring plan should include thresholds (e.g., degree of fragmentation, loss of habitat) that would trigger management and policy intervention.
g. ***Develop clear links to decision making*** – The monitoring plan should clearly identify linkages between the monitoring data and decision makers.
h. ***Communicate results*** – There are many potential stakeholders who will be interested in the results of monitoring, and therefore any monitoring program should have a clear communications plan.

INSERT TEXT BOX WITH EXAMPLES OF OBJECTIVES AND RELATED INDICATORS, AND METHODS FOR MONITORING A CONNECTIVITY INITIATIVE

Sample indicators for monitoring connectivity initiatives

131. The following are some sample indicators that planners could use to monitor the status and/or the effectiveness of connectivity initiatives:

a. Species and habitats :
Fragmentation indices
Population trends
Species movement across new connectivity features

b. Protection :
Amount and category of protected area within connectivity gaps
Protected area management effectiveness for connectivity across the PA system

c. Policies :
Number of policies amended to enable better connectivity

Further reading, references and links on monitoring status and effectiveness

SECTION III: CASE STUDIES

The following three case studies, that can serve as examples, are taken from Dudley N and M Rao, 2008. Assessing and creating linkages within and between protected areas. Quick Guide. Arlington, VA: The Nature Conservancy.

Case study 1: Kinabatangan River – restoring linkages along an area of critical freshwater habitat in Sabah,Malaysia

132. Biological corridors and issues of connectivity are as important in aquatic environments as on land; in some cases rivers can also act as a focus for maintaining more general connectivity. In the Malaysian state of Sabah, on the island of Borneo, extensive oil palm establishment has fragmented remaining natural forest, threatening species such as the orangutan, the Borneo subspecies of the Asian elephant and hornbills. The Kinabatangan River acts as a partial corridor between remaining mountain forests and coastal mangroves.

133. However, the line of riparian forest at its edge has been broken in places by illegal planting of oil palms right down to the river banks, and deforestation in the lowland mountains is causing increased flooding and impacting water quality. The river is experiencing infestation with exotic water hyacinth in places, and, more seriously, the weed is also clogging some associated lakes, changing their character and making some of them unsuitable for native otter. A road cuts across the river just before the upland forests, which has isolated a population of around a hundred elephants in the lower part of the river, where they cause tensions by crop raiding and are occasionally shot at by oil palm workers (Dudley et al., 2008).

134. Various state agencies and NGO conservation projects are trying to maintain and where necessary restore the freshwater and associated forest corridor through:

- Protecting remnant forest and mangrove areas in both government-owned and private protected areas, to maintain wildlife but also to contribute to sources of pure drinking water and to flood mitigation (Azmi, undated)
- Undertaking strategic replanting of trees to re-connect forest fragments along the course of the river
- Helping local communities to build up ecotourism and provide an outlet for local fish products
- Working with some community conserved areas, including a forest preserved as habitat for a colony of swiftlets that are a source of valuable “birds nest soup” found in a local cave system
- Liaising with oil palm companies in an attempt to reclaim areas in the floodplain that are poor habitat for oil palm and could be restored
- Working with timber companies to introduce reduced impact logging in the upland forests and to prevent conversion to oil palm

• Attempting to reduce pollution and invasive plants in the river system to maintain healthy aquatic life including commercial fish harvest

135. The various projects aim to develop the Kinabatangan into a permanent freshwater and forest corridor linking the largest remaining blocks of upland forest and coastal forest in the region.

Case study 2: Mesoamerican Biological corridor – linking reservesin eight countries

136. Although the concept of transboundary conservation started with two countries, multi-country initiatives are becoming increasingly common. The Mesoamerican Biological Corridor (MABC) aims to create a continuous corridor of habitat capable of sustaining biodiversity in the five southern states of Mexico and seven Central American states: Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica and Panama. The region has extremely high levels of biodiversity – for example Panama contains more bird species than the United States and Canada combined. The MABC is joining together protected areas with various buffer zones and corridors, trying to use the corridor concept to help add value to products produced in the linking areas.

137. The corridor was initiated in 1997 and since then the Central American Commission for Environment and Development has worked with national and international partners to help make it a reality (Miller et al., 2001). Originally perceived as literally a corridor linking a range of protected areas, the MABC is now more of a concept of a landscape approach for Central America, involving all the protected areas in the region and intervening land. Currently there are around 600 protected areas, covering a fifth of the region. But most contain human populations, including many of the original indigenous peoples, and the survival and success of conservation efforts will depend on maintaining a strong focus on the needs of people along with that of biodiversity. The extent to which many of these areas will remain as traditional protected areas or merge more into some kind of sustainable development areas remains uncertain and protected areas also remain under political pressure in some countries.

138. Given the human pressures and lack of money in the area, integration of conservation with economic objectives is a keystone of the concept. This integration takes the form of three main types of market opportunity: tapping environmental services such as aquifer recharge or soil stabilization; exploring green businesses including particularly ecotourism; and establishing niche markets for shade-grown coffee, organic products and other products of the corridor. The frequency of devastation linked to extreme weather events such as Hurricane Mitch over the past few decades means that the role of natural ecosystems in disaster relief is particular important in this context. The MABC is hugely ambitious in scope and concept although it is still uncertain the extent to which political realities in the region allow it to be completed in the manner originally envisaged.)

Case study 3: NamKading National Protected Area – using the Landscape species approach in Lao PDR

138. Many attempts at linking landscapes start from a single protected area. The Bolikhamxay Province in Lao PDR contains the highest quality dry evergreen forest left in Indochina, with the largest block centered on the 1570 km2 Nam Kading National Protected Area. Many important species occur and some, like the large hornbill, cannot survive without large areas of this forest (Duckworth et al., 1999). In the eastern province, bordering Vietnam, areas of wet evergreen forest in and around the Nam Chat-Nam Pan Provincial Protected Area contain ice age refugia, including several newly described species such as Saola (Pseudoryx nghetinhensis) and Annamite Striped Rabbit (Nesolagus timminsi). Conserving this globally important biodiversity with the Landscape Species Approach is a key goal of the Wildlife Conservation Society's programme in Lao PDR.

139. Using a WCS Species Selection Software (Strindberg at al 2006), the project brought together government, community and NGO stakeholders to select seven landscape species for the province: Asian elephant (Elephas maximus), tiger (Panther tigris), southern serow (Naemorhedus sumatraensis), Eurasian wild pig (Sus scrofa), white-cheeked crested gibbon (Nomascus leucogenys), great hornbill (Buceros bicornis) and Asian redtail catfish (Hemibagrus wyckoides) (Strindberg 2006). Government staff worked with WCS ecologists to create a Conservation Landscape for each species; i.e. maps identifying areas that are a management priority for the species. The team identified and mapped the best habitat for each landscape species (biological landscapes), and then mapped the location and relative importance of human-caused threats (threats landscapes) (Rasphone et al 2006, Johnson et al., 2006).

140. The completed maps helped to build conceptual models and define population targets for six of the landscape species:

- A 10 percent increase in white-cheeked crested gibbon population
- A 35 percent increase in great hornbill population
- A 20 percent increase in tiger population
- A 50 percent increase in southern serow population
- A 100 percent increase in Eurasian wild pig population
- No decline in Asian elephant population

141. The team identified management interventions (e.g., reduction of hunting, wildlife trade and habitat loss) needed to reach the targets, and worked with a WCS biostatistician to design a monitoring program to measure population change for landscape species during the project. Limited resources, a rugged terrain and the elusive nature of many of the landscape species made this a challenge. However, a monitoring program using camera trapping and line transects is now allowing WCS to measure the effectiveness of interventions in the Nam Kading NPA (Strindberg at al., 2007), and to adapt actions accordingly.

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